SECTION XVI

SALES ANALYSIS SPECIFICATIONS - TABLE OF CONTENTS

SALES ANALYSIS SPECIFICATIONS

INTRODUCTION

Deeds activity, Multiple Listing Service information, and associated transaction dealing with buyers (grantee) and sellers (grantor) provides the basis for continuing study of the relationship between APPRAISED VALUE and SELLING PRICE. This relationship is known as the assessment ratio and is expressed as a percentage.

North Carolina law requires that real property be appraised at 100% of its current market value or, in other words, if for example, a property sells for $85,000 and this selling price is determined to be the subject's market value, then the Uniform Schedule of Values as adopted by the Board of County Commissioners should reflect an appraised value of $85,000. The assessment ratio in this example is 100%

$$\frac{\$85{,}000 \text{ Appraised Value}}{\$85{,}000 \text{ Market Value}} = 100\%$$

Obviously, sales information which is incorrect, incomplete, or occurring in such a fashion that it does not reflect the actual market value of a subject property (i.e., not an arms-length transaction) will distort this assessment ratio and lead to erroneous conclusions.

The responsibility of the technician assigned to analysis of incoming sales information is therefore critical to the appraised process.

SALES RATIO STUDY

A sales ratio study compares the assessed value to the sales price based on a random sample of recorded deed book and pages provided by the NCDOR. This study is performed annually. The NCDOR uses the study to determine the level of assessment and for equalization of public service companies. The assessed value of public service company system property subject to appraisal by the Department of Revenue shall be determined by applying to the allocation of such value a percentage in the year a county conducts a reappraisal of real property and in the fourth and seventh years thereafter. If the median ratio for real property in any county is below ninety percent (90%), the weighted average percentage shall be applied to public service company property (see NCGS 105-284). The preliminary ratio for Rutherford County for the 2011 ratio study (4^{th} year after reappraisal) is 100.05%. Based on this number equalization of public service companies will not occur.

ASSESSMENT RATIO STATISTICS

Because assessment ratio studies deal with uncertainties surrounding the accuracy of assessments and because statistics are a means of reducing uncertainty, some statistical concepts are of fundamental importance. An assessment ratio study is a form of applied statistics. Applied statistics groups relatively few raw numerical observations to make meaningful statements about a larger group. The purpose of grouping or classifying data is to facilitate the extraction of useful information. The grouping destroys much original detail, but valuable insights can be gained from the overall picture.

Statistics deals with populations—the total data that can possibly be collected – and samples, which are smaller, easily obtained representative subsets of the population. Inferences and descriptive measures about the population may be made on the basis of information from only a small segment, or sample, of the whole – a procedure termed statistical inference. When applied to a sample, the calculated descriptive measures are called statistics when applied to a population, these measures are called parameters.

Because in assessment ratio analysis we are most concerned with information about all properties of a certain type in a jurisdiction, little attention is given to the individual properties except for measuring them accurately. Direct analysis of all properties in a jurisdiction (the population) can be inefficient, uneconomical, and sometimes even impossible. Fortunately, it is not necessary to analyze each property individually in order to obtain information on the population of properties. We can take the assessment ratio of some of the properties (a representative sample), summarize what we know about them, and use statistics to describe the assessment ratio parameters of the entire population of properties. We thereby "infer" from the sample the assessment accuracy to the population being studied.

Prior to statistical analysis of assessment performance, the assessment ratio of each data point in a sample must be calculated. Data on individual assessment ratios are required for all assessment-ratio statistics or tests. From these ratios, central tendency and dispersion measures can be calculated.

CENTRAL TENDENCY

Central tendency measures are elementary statistical descriptions. Commonly called "averages", they described in a single statistics the overall level at which property is assessed. The term "central tendency" implies that we are trying to locate the middle of a set of data points in order to describe that set. Comparing central tendency measures can reveal systematic (as opposed to random) inter-group variability – assessment biases among use classes, age groups, value ranges, neighborhoods etc.

The two measures of central tendency most useful in describing assessment ratio data and assessment levels are then mean and the median. Each yields a different measure of assessment level, although they should be similar (large differences between these measures indicate undesirable features in the pattern of assessments). Each has its own most appropriate uses. Both indicate how closely to the legal ratio properties are being assessed. Both should be calculated for a sample, if only for comparison purpose.

CENTRAL TENDENCY - MEDIAN

The median assessment ratio (A/S) is the middle value when a set of ratios is arrayed (listed in increasing or decreasing order). The median divides the set into two equal groups.

If there is an odd number of ratios in a sample, the median is that ratio ranked as (n+1) /2, where "n" is the number of ratios. For example, if there are 25 ratios, the median is the thirteenth ratio [(25 + 1)/2]; there are twelve larger ratios and twelve smaller.

If the number of ratios is even, the median is the midpoint between the two middle ratios. Consider the (8) assessment ratios in Table 1. In column (4), the ratios are presented in order of magnitude. The median is the midpoint between the fourth and fifth largest ratios: [(0.500 + 0.520/2]=0.510.

The median has several desirable properties. First, it is not influenced by extreme ratios (often called outliners). The median A/S ratio also provides an unbiased estimator of the median A/V ratio, where "V" represents the market value. This is important, because we are interested in measures of central tendency only to the extent that they describe the true ratio of assessments to market values. Sales prices are really only substitutes for, or estimators of, market values. The fact that the median A/S ratio permits us to conclude, for example, that, if A/S = 0.80, very close to half the properties in the sample are assessed below 80 percent of their market values and the other half above 80 percent of their market values. This is what we expect A/S = 0.80 to imply.

The median is generally the preferred measures of central tendency when assessment ratio studies are used as internal performance measurements.

CENTRAL TENDENCY – MEAN

The mean assessment ratio, written symbolically as A/S, is the simple average of the ratios, or the mathematical center of the distribution. It is more precisely termed "arithmetic mean" or "simple mean". It is found by adding the ratios and dividing the result by the number of ratios. In Table 1 (page 13) the mean assessment ratio is 0.570 (4.550/8).

The mean is influenced by every observation in the distribution and is more affected by extreme ratios than is the median. (The analyst may wish to delete true outliners from the study if they can be considered aberrations.) For example, in Table 1, if the last ratio were 1.930, the mean would then be 0.695 (5,560/8), but the median would say the same.

In one sense, it is desirable that the mean fully reflects extreme ratios in the sample and that, by shifts in the calculated assessment ratio, the assessor can be made aware that these extreme ratios do exist. It is undesirable because the mean does not necessarily reflect the level at which the bulk of the properties are assessed.

Because sales are only indicators of market values, the A/S ratio is a biased estimator of the A/V (mean assessment to value) ratio. Although it is not preferred statistic, the mean assessment ratio, like the median, can be used as an internal control, especially when the distribution of assessment ratios can be considered normal.

ASSESSMENT RATIO STATISTICS – DISPERSION MEASURES

Although the median and mean are each single numbers that are representative of and described the "center" of the entire set of measurement from which they were derived, they do not, by themselves, give any detail about the distribution of the original measurements. No central tendency indicator can be meaningfully interpreted without some indication of the spread, or scatter, of the data points about the value. Dispersion can be attributed either to the assessor's performance or to vagaries in the market. Other information must be considered in order to get a more informative picture of the distribution. Intra-group (within a property group) departures from uniformity are evaluated using dispersion measures.

There are two types of dispersion measures, variability and relative variability. Measures or variability make analysis of the data meaningful, and measures of relative variability make it even more so. These measured, which should be calculated for each property type being analyzed, seek to describe in one convenient statistic the degree of non-uniformity in assessment ratios.

DISPERSION MEASURES - MEASURES OF VARIABILITY

Measures of variability are measures of the distances that the individual observation lie from the measure of central tendency. These measures show the spread of the data without regard to a normal, or standardized, value. In the assessment field, the three most common measures of variability are range, the average absolute deviation, and the standard deviation.

The range of the data is simple to compute – it is merely the difference in magnitude between the highest data value and the lowest data value. Based on the accompanying data, it is easy to discern that the range for Sample A is 0; for Sample B, 0.15 (0.40 – 0.25); and for Sample C, 0.40 (0.55 – 0.15). Because the range takes into consideration only two data values, it is totally affected by the extreme values and is not very useful in evaluating the bulk of the properties. The range also cannot be statistically manipulated any further.

Data...	Sample A:	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Sample B:	0.39	0.38	0.39	0.37	0.25	0.40	0.39
	Sample C:	0.18	0.16	0.50	0.19	0.15	0.16	0.55

Medians:	Sample A	1.00
	Sample B	0.39
	Sample C	0.18

Ranges.:	Sample A	0
	Sample B	0.15
	Sample C	0.40

MEASURES OF VARIABILITY

AVERAGE ABSOLUTE DEVIATION

The average absolute deviation (often referred to as the "average deviation") indicates the average distance, without regard to direction, that the observations lie from the measure of central tendency. Unlike the range, it is affected by every data point in the sample.

It is calculated as follows:

1. The value of the sample measure of central tendency is subtracted from each observation, ignoring the sign (plus or minus) of the result;

2. The results are summed; and

3. The sum of the results is divided by the number of observations.

Because the average absolute deviation show the average distance of observations from the central tendency measure, it demonstrates the spread of the data points. The dispersion will be small if assessment ratios are clustered closely about the measure of central tendency and large if the ratios are spread considerably. Although the mean may be used, calculation of the average absolute deviation about the median is preferred because the median provides a more stable measure of central tendency. The average deviation by itself is not very useful. It is the basis, however, for an extremely useful measure of relative variability, the coefficient of dispersion (COD).

STANDARD DEVIATION

The standard deviation, denoted by "s", differs from the average absolute deviation in that the differences between each observation (A/S) and the mean (A/S) are squared and the summed. It too is affected by every observation in the sample.

Calculated only from the mean – it is the square root of the sum of the squared deviations from the mean, divided by the number of observation minus one. (The denominator is "n-1" because of the statistical concept of "degrees of freedom", which has the effect of minimizing the bias structured into the data). The squaring process results in the "weighing" of the extreme values; a large difference will account for proportionally more than a small difference. (The deviations are not weighted when using the average absolute deviation). Greater emphasis is therefore placed on the extreme ratios. The principal application of the standard deviation is strengthened by the unique relationship it has with the "normal" distribution. The standard deviation can be a reliable estimate of the percentage of observations included within a given distance of the mean of a normal distribution. The standard deviation is the basis for the relative measures of variability termed the coefficient of variation (COV).

MEASURES OF RELATIVE VARIABILITY

Although it is valid to compare the standard deviations or the average absolute deviations of two or more groups of assessment ratios that have equal measures of central tendency, such comparisons are invalid and misleading if the groups have widely different central tendency measures. For example, assume that the standard deviations of assessment ratios in two districts are both 0.15. If the A/S ratios in both districts are equal, one can assume that variations in assessment ratios in both districts are equal. On the other hand, if the A/S of the first district is 25 percent but the A/S of the second district is 50 percent, it is apparent that the variation within the second district is double that of the first district.

For comparison of this type, it is necessary to analyze the relative (relative in the sense that the deviation is expressed as a function of the central tendency measure) variation about the measure of central tendency. The most useful relative measures of assessment variation are the COD and the COV. Other measures, used less often, are weighted COD and the weighted COV. The smaller each of these coefficients is, the more uniform are the assessments. If the coefficients are too small (near zero), however, a problem may exist; perhaps only recently sold properties and older ones have been appraised. In most cases, the COD (as calculated about the median) will produce the most satisfactory results in assessment ratio work.

COEFFICIENT OF DISPERSION

The COD is the most useful measure of assessment variability. It is an example of "nonparametric" statistics – the validity of the statistic does not rest on assumptions about the distribution of the data. Nonparametric statistics are generally easier to understand and apply than are parametric statistics.

The COD is the average absolute deviation of all assessment ratios from the chosen measure of central tendency, expressed as a percentage of that measure. The COD is most commonly calculated using the median assessment ratio (A/S) and is written as COD.

Six steps are required to calculate the COD:

1. Compute the difference between each assessment ratio and the measure of central tendency;

2. take the absolute value of the difference;

3. sum the absolute differences;

4. divide that sum by the number of observations to obtain the average absolute deviation;

5. divide the average absolute deviation by the measure of central tendency;

6. multiply that quotient by 100.

The COD weights deviations from the central tendency measure by their absolute values. It is easily interpreted regardless of the distribution of A/S ratios.

Referring again to Table 1: to calculate the COD of these properties, the average absolute deviation must first be found. The individual deviations from the median are listed in column (6) and total 0.700; dividing this by the number of observations (eight) results in 0.0875; multiplying this by the result of 100 divided by 0.510 (the median), results in a COD of 17.2. (Dividing by the median facilitates comparisons between two or more groups. Multiplication by 100 is merely a convention for purpose of expressing the deviation as a whole number rather than as a decimal).

As mentioned earlier, the COD can also be computed with respect to the mean; such calculations merely require the substitution of the appropriate measure of central tendency in two positions in the formula.

COEFFICIENT OF VARIATION

The coefficient of variation (COV) is the second most widely used measure of assessment variation. The COV is an example of "parametric" statistics. The validity of the inferences drawn from parametric statistics rests on the assumption that the data are normally distributed, an assumption that generally is not valid when the data are assessment ratios. The COV is the standard deviation of the assessment ratios expressed as a percentage of the mean assessment ratio. It should not be computed about the median.

Seven steps are involved in calculating the COV:

1. Compute the difference between each ratio and the mean ratio;

2. square the difference;

3. sum the squared differences;

4. divide the sum by the number of observations less one;

5. take the square root of that quotient to obtain the standard deviation of the assessment ratios;

6. divide the standard deviation by the mean;

7. multiply the quotient by 100.

The COV weights deviations from the mean on the basis of squared values of the deviation. Referring to Table 1 (page 13): to calculate the COV of these properties, the standard deviation must first be found. The individual deviations from the mean are listed in column (6); the squared deviations, which total 0.1670, are listed in column (7). Dividing 0.1670 by the number of deviations minus one equals 0.0239. The standard deviation must then be calculated – the square root of 0.0239 is 0.1546. This standard deviation, when multiplied by 100 and divided by the mean (0.570), results in a COV of 27.1. This final step converts the standard deviation to a percentage and, thus, facilitates comparison between two or more groups.

Interpretation of the COV rests on whether or not assessment ratios can be regarded as normally distributed. A normal distribution is characterized by a symmetrical, bell-shaped curve, and it can be completely described by its mean and standard deviation. Once these are known, the percentage of observations falling within any given range of the mean can be calculated.

Where the A/S ratios are normally distributed, the COV is more useful than the COD, because it completely describes the distribution and provides a more complete picture of relative variability. The main point, however, is that blind reliance on the COV as a dispersion measure is to be avoided.

WEIGHTED COV AND COD

The weighted COV and the weighted COD can be used to monitor the extent to which assessment variability is related to the value range of properties. A comparison of these measures with their unweighted counterparts will indicate whether relatively high value properties are being assessed with either more or less variability than relatively low value properties.

PRICE RELATED DIFFERENTIAL

The price related differential (PRD) measures the assessment level differences between high and low priced properties. It is another measure of the extent to which assessment variability is related to the value range of properties. The PRD, calculated as the mean assessment ratio divided by the aggregate ratio, will indicate if properties sold at higher prices tended to be undervalued (had lower assessment ratios) as compared with those sold at lower prices. Such a situation, termed "regressive", tends to occur with many mass appraisal systems and places an undue tax burden on the owners of lower priced properties. The opposite situation is termed "progressive". Both conditions are types of vertical inequity, in that they describe patterns of inequity that exist across value ranges. In contrast is horizontal inequity, which measures assessment variability across the same value class.

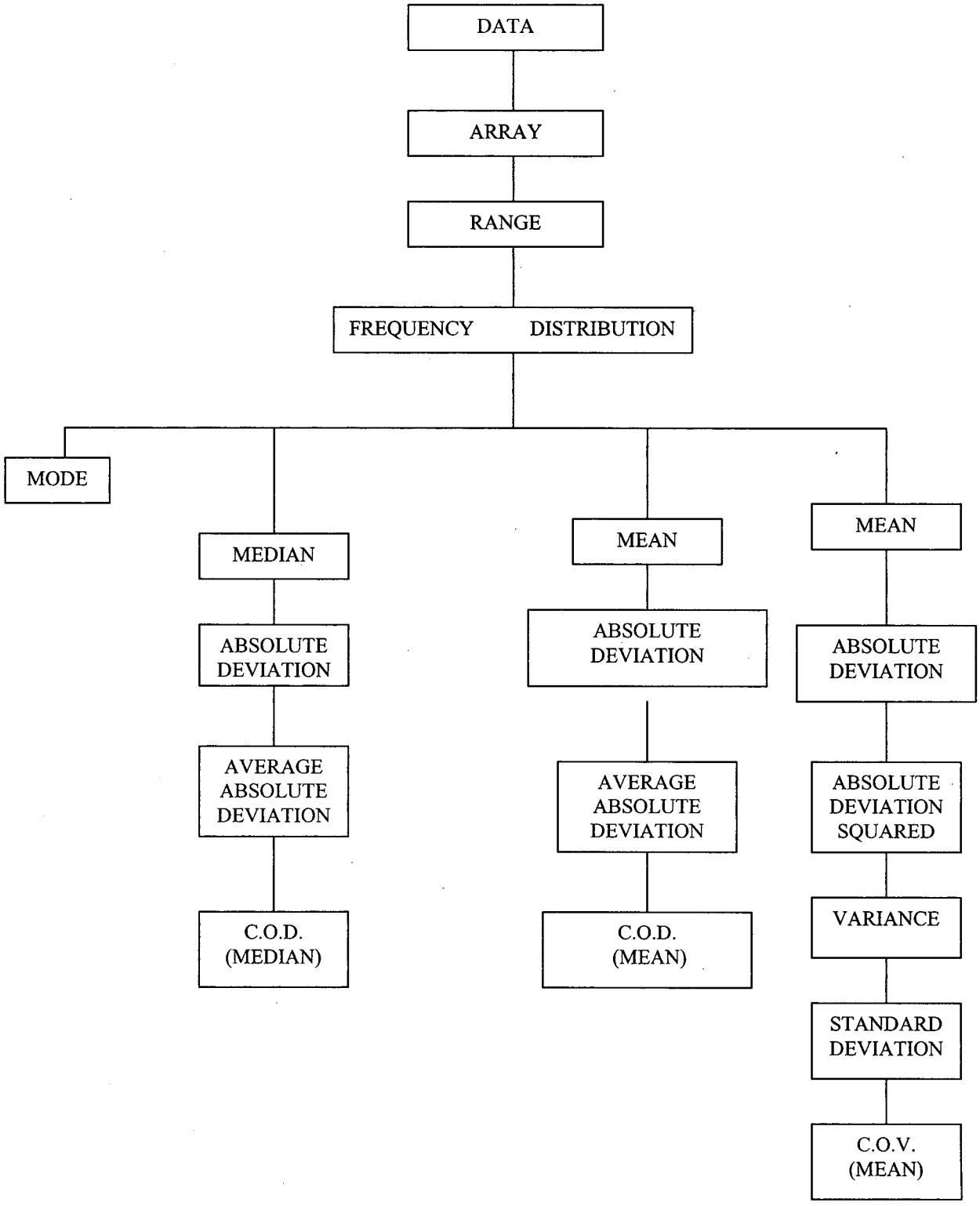
EVALUATING THE RESULTS

Assessment ratio studies reduce uncertainty about assessment accuracy by providing an objective basis for evaluating assessment level and uniformity. Yet the studies do not eliminate uncertainty: Judgment is always required. Also, the results of A/S ratio study should only be used in ways consistent with the purposes for which the study was designed.

Assessment ratio data are frequently misunderstood. Interpretive information and a well-presented A/S study will help reduce this misunderstanding. The uses of an A/S study depend in large part on how the final study is presented and how clear it is. A formal study should be accompanied by a text describing the purpose of, the authority for, and the methods used in the study. The amount of detail in the text will depend on the audience to whom it is presented. It should at least contain a definition of key terms, the statistics use, and outline of steps undertaken, and acknowledgment of the limitations of the data. Tables and figures, neatly laid out and clearly labeled, should also be included. Finally, a dispassionate statement of trends or patterns revealed by the findings should be prepared. A "working" in-house study requires less sophistication, of course.

See statistics flow chart on next page.

STATISTICS FLOW CHART



SAMPLE OF MEASURES OF CENTRAL TENDENCY AND VARIABILITY

Table 1

Appraised Value (1)	Sale Price (2)	A/S (3)	A/S- A/S (4)	A/S-A/S (5)	(A/S-A/S) (6)	$(A/S - \overline{A/S})$ (7)	S (A/S) (8)	A-S(A/S) (9)	2 S(A/S-A/S) (10)
$36,000	$80,000	.450	-060	-.060	-.120	.0144	$40,800	$4,800	$1,152
30,000	62,500	.480	-030	.030	-.090	.0081	31,875	1,875	506
25,000	50,000	.500	-.010	.010	-.070	.0049	25,500	500	245
13,000	26,000	.500	-.010	.010	-.070	.0049	12,260	260	127
20,800	40,000	.520	.010	.010	-.050	.0025	20,400	400	100
30,000	53,600	.560	.050	.050	-.010	.0001	27,336	2664	5
12,400	25,800	.930	.420	.420	.360	.1296	13,158	10,842	3,344
$191,200	$357,900	4.560		.700	.000	.1670		$23,541	$5,529

Measures of Central Tendency:

Median Assessment Ratio A/S = 0.510

Mean Assessment Ratio $\overline{A/S} = \frac{4.560}{8} = 0.570$

Measures of Variability:

Coefficient of Dispersion $COD = \frac{100}{0.510} \Big/ \frac{0.700}{8} = 17.2$

Coefficient of Variation $COV = \frac{100}{0.570} \Big/ \sqrt{\frac{0.1670}{7}} = 27.1$

Aggregate Ratio $\overline{A/S} = \frac{\$191,200}{\$357,9000} = 0.534$